Appendix B

October 2002

Cougar Reservoir Temperature Control Project
Sediment Quality Evaluation

June 4-5 & August 6-7, 2002
Sampling Events

Prepared by Portland
District Corps of Engineers

Appendix B
Cougar Reservoir Temperature Control Project
Sediment Quality Evaluation

ABSTRACT

In 1996, during the design phase of the project, Geotechnical Resources Inc. submitted twelve (12) surface grab sediment samples for physical and chemical analyses. These samples were collected at the 1400' contour near the intake structure and diversion tunnel and upstream locations, with results published in the Design Memorandum No. 21. No organic contaminates were detected above method detection levels (MDL) and metals were detected only at low levels and were considered at background levels. However, with the greater than anticipated amount of erosion and resulting turbidity during the drawdown process, questions from the public were raised about potential contaminate levels in the turbidity and possible sediment releases. As a result, twelve (12) surface sediment samples, targeting fine-grained sediment and organic material, were collected in June 2002. These samples were collected to target fine-grain and organic material that had been eroded during the drawdown, with one (1) sample to represent lakebed sediments, which were exposed after the drawdown event. All samples were submitted for physical parameters including total volatile solids and five (5) samples were chemically analyzed for heavy metals (9 inorganic), total organic carbon, pesticides and polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables and polynuclear aromatic hydrocarbons.

Dichlorodiphenyltrichloroethane (DDT) was detected above levels of concern[1,2] in four (4) of the five (5) samples collected during the June sampling event. As a result of these findings, a follow-up sampling event was conducted on August 6-7, 2002, which analyzed fifteen (15) samples for physical parameters, total organic carbon (TOC) and total DDT (DDT+DDE+DDD or Σ DDT). This event detected no Σ DDT, at MDLs (Method Detection Limits), present in surface sediments taken at two (2) locations in the McKenzie River, downstream of the dam and upstream of the reservoir. Only low levels of Σ DDT (~15% of S.L.) were detected near the inlet to the diversion tunnel, with one (1) of five (5) samples collected from within the current reservoir exceeding screening levels for Σ DDT [1,2] (see Table 9, pages 14-16 for complete results). Samples collected from potential future erosive sites, within the reservoir, contained Σ DDT at levels above the S.L [1,2]. Future sediment monitoring is recommended during winter storm events, to document turbidity and potential sediment migration to evaluate potential transport of Σ DDT.

---

[1] Dredge Material Evaluation Framework – Screening level for open water disposal 6.9 ug/kg total DDT.
[2] Oregon Department of Environmental Quality – Level II screening level 7.0 ug/kg total DDT.
[3] See Attachment A & B for complete Sampling and Analysis Plans

INTRODUCTION

This report will evaluate analytical data from both the June and August 2002 sampling events. The goal of the June 2002 sampling event[3] was to target fine-grained sediment and organic material, because most contaminates of concern bind to these substrates. The samples taken in the June event, from cutbanks adjacent to areas of erosion, collected to represent the eroded material, targeted only the fine-grained and organic lens within the vertical profile and did not represent the entire volume of material that has been eroded. Due to the detection of Σ DDT in these samples, the August 2002 sampling event[3] attempted to satisfy the following questions, with the corresponding action:

Appendix B
Cougar Reservoir Temperature Control Project
Sediment Quality Evaluation

1. What levels of Σ DDT are in the background?

Collect background sediment from above the reservoir on the South Fork of the McKenzie (both in-water and upland).

2. What levels of Σ DDT are represented in the total volume of sediment eroded and those that have a potential for future erosion?

   Collect vertical profile samples from the cut-bank areas where only the fine-grained sediment was targeted in the first sampling event in June were collected.

3. What levels of Σ DDT are exposed in the current reservoir?

   Collect surface sediment, which has recently been eroded and homogenized during the drawdown even, from all the newly formed delta areas in the current reservoir (1400 foot level).

4. What levels of Σ DDT might have migrated beyond the confines of the reservoir?

   Collect recently deposited sediment from just below the dam that would represent sediment that was released during the drawdown.

PREVIOUS STUDIES

In February of 1996 twelve (12) surface grab sediment samples were submitted, by Geotechnical Resources Inc., to the Corp's materials lab (Troutdale, OR) for physical analysis and Sound Analytical Services laboratory for chemical analyses. These samples were collected, from within the reservoir, at the 1400' contour near the intake structure and diversion tunnel and several upstream locations. Physical parameters included soil classification, particle size and dredge test analysis, with analysis varying from 80% gravel to 90% silt. Chemical methods TPH-HCID (petroleum hydrocarbon identification) with quantification for gasoline, TPH-418.1 (Total Recoverable Petroleum Hydrocarbons), 8 RCRA metals, 1311 TCLP (leachability of metals), EPA 200.8 (Trace metals), 7471 (lead), 8080 (chlorinated pesticides and PCBs) and TOC (total organic carbon) were performed on select samples. No organic contaminates were detected above method detection levels (MDL) and metals were detected only at low levels and are considered at background. The laboratory encountered some minor problems with matrix interferences causing recovery levels for several surrogate analyses to be outside the recommended range. These problems are considered minor and do not affect the confidence on the overall data objectives.

CURRENT STUDIES

JUNE 4-5, 2002 SAMPLING EVENT

During the drawdown process, erosion of the fine-grained sediment delta areas, formed where tributaries enter the reservoir, had occurred. The eroded sediments caused turbidity and sedimentation concerns within and downstream of the reservoir. In addition to the concern of turbidity levels, the question of possible distribution of contamination, contained within the sediments, had arisen.

Appendix B
Cougar Reservoir Temperature Control Project
Sediment Quality Evaluation

Members of the public expressed concern for the presence of some heavy metals and the use of herbicides and pesticides in areas upstream of the reservoir. Due to the large amounts of sediment being eroded and the concerns expressed, sampling was scheduled.

Twelve (12) physical and five (5) chemical analyses were collected from delta areas. Physical parameters included soil classification, particle size and dredge test analysis, with chemical analyses including: metals (6020/7471), total organic carbon (TOC) method 9060, polynuclear aromatic hydrocarbons (PAHs), phenols, phthalates, chlorinated organic compounds, misc. extractables by 8270 SIM method (low level detection method), pesticides/PCBs by 8081/8082 and chlorinated herbicides by method 8151, conducted by Severn Trent Laboratory in Tacoma. DDT and its breakdown products were the only chemicals detected at levels of concern. [1,2]

The following areas were selected for chemical analyses (with corresponding Σ DDT levels as indicated), two (2) samples were collected from East Fork cut banks (Σ DDT @ 8.5 & 32.6 ppb), one (1) sample below from below the Slide Creek boat ramp, from a delta cut bank (Σ DDT @ 23.9 ppb), one (1) sample from the Annie Creek delta (Σ DDT @ 18.6 ppb), and one (1) sample was collected from lake deposits near the face of the dam on the Rush Creek side (Σ DDT @ 5.3 ppb).

Table 1. June 4 & 5, 2002 Sampling Event, Sampling Station Coordinates (NAD 83, Oregon State Plane South) (Coordinates for samples submitted for physical analysis only, not available).

COUG-G-05 44º 04.846’ 122º 13.670’ Slide Creek – main channel bank.	COUG-G-07 44º 07.145’ 122º 13.726’ North bank of East Fork.	COUG-G-09 44º 07.181’ 122º 13.561’ North bank of East Fork.
COUG-G-11 44º 07.616’ 122º 14.443’ Lake deposit – mid-dam	COUG-G-13 44º 05.949’ 122º 13.778’ Annie Creek – Near main channel.	

AUGUST 6-7, 2002 SAMPLING EVENT

During the August event fifteen (15) samples were collected and analyzed for Σ DDT, total organic carbon (TOC) and physical parameters; this was a follow-up to the Σ DDT detected, above SL, in the June event. Basic objectives are stated in the Introduction section above, as well as, in the SAP attached in Attachment B. The samples were collected as follows: two (2) background samples collected from the South Fork of the McKenzie above the reservoir; three (3) vertical profile samples from the cut-bank areas, where only the fine-grained sediment was targeted in June; five (5) surface composite sediment samples collected from the reservoir, to represent the recently eroded and re-homogenized sediment from the drawdown even. Each of these five (5) samples analyzed were a composite of 2-3 surface grabs from designated areas within the current reservoir. Two (2) additional surface samples were collected, downstream of the dam, on the McKenzie River, from slack water areas where Σ DDT might have been deposited, if it had migrated beyond the confines of the reservoir. One upland station was sampled and two samples submitted for analyses. These samples were collected from forest floor debris, about one-half mile northeast of the bridge crossing the South Fork, upstream of the reservoir. Samples represented the surface - 6”depth and 6”-12” depth of forest floor debris.

Appendix B
Cougar Reservoir Temperature Control Project
Sediment Quality Evaluation

Table 2. August 6 & 7, 2002 Sampling Event, Sampling Station Coordinates (NAD 83, Oregon State Plane South).

COUG-G-14 (No GPS Reading Available) Downstream of Powerhouse – east bank.	COUG-G-15 44º 08.568' 122º 14.323' USGS gauging station	COUG-G-16 44º 03.373' 122º 13.127' Upstream of reservoir.
COUG-G-17 44º 03.395' 122º 13.133' Upstream of reservoir.	COUG-G-18 44º 02.816' 122º 12.961' Upland – above reservoir.	COUG-G-19 44º 02.816' 122º 12.961' Upland – above reservoir (same location as COUG-G-18.
COUG-G-20 44º 04.732' 122º 13.671' (Same location as COUG-G-06) Slide Creek – main channel bank.	COUG-G-21 44º 04.843' 122º 13.664' (Same location as COUG-G-05) Slide Creek – main channel bank.	COUG-G-22 44º 07.138' 122º 13.720' (Same location as COUG-G-07) North bank of East Fork.
COUG-G-23 44º 07.178' 122º 13.568' (Same location as COUG-G-09) North bank of East Fork.	COUG-G-24 44º 07.035' 122º 14.026' 44º 07.035' 122º 14.036' 44º 07.034' 122º 14.036' Composite of 3 samples in delta of East fork – after drawdown.	COUG-G-25 44º 06.433' 122º 13.918' 44º 06.431' 122º 13.924' 44º 06.447' 122º 13.965' Composite of 3 samples in delta of South fork – after drawdown.
COUG-G-26 44º 06.724' 122º 13.935' 44º 06.734' 122º 13.932' Approximately halfway between East Fork & South fork. Composite of 2 samples from both sides of Reservoir – after drawdown.	COUG-G-27 44º 07.507' 122º 14.490' 44º 07.539' 122º 14.431' 44º 07.590' 122º 14.393' Composite of 3 samples near inlet to diversion tunnel – after drawdown.	COUG-G-28 44º 07.534' 122º 14.306' 44º 07.546' 122º 14.306' 44º 07.538' 122º 14.300' Composite of 3 samples in delta at Northeast end of reservoir – after drawdown.

Appendix B
Cougar Reservoir Temperature Control Project
Sediment Quality Evaluation

RESULTS – JUNE 4-5, 2002 & AUGUST 6-7, 2002

Physical and Total Volatile Solids (TVS) (ASTM methods).

June Event: Twelve (12) samples were submitted for physical and TVS analyses; data are presented in Table 3. Four (4) samples were classified as "silt with sand, five (5) samples were classified as "silt" and three (3) samples were classified as "sandy silt." Mean grain-size for all the samples is 0.04 mm, with 0.06% gravel, 22.0% sand and 78.0% fines. Volatile solids for all the samples ranged from 25600 mg/kg to 82200 mg/kg.

August Event: Fifteen (15) samples were submitted for physical and TVS analyses; data are presented in Table 8. Five (5) samples were classified as "silty sand". Two (2) samples each were classified as "silt with sand", and "sandy silt." One (1) sample each was classified as "poorly graded gravel", "poorly graded sand with gravel," "poorly graded sand," "well graded sand with, gravel," "poorly graded sand with silt and gravel" and "elastic silt." Mean grain-size for all the samples is 1.29 mm, with 14.8% gravel, 51.85% sand and 40.45% fines. Volatile solids for all the samples ranged from 1390 mg/kg to 53700 mg/kg.

Metals (EPA method 6020/7471), Total Organic Carbon (EPA method 9060).

June Event: Five (5) samples were submitted for testing and the data are presented in Table 4. The TOC ranged from 10,800 to 103,000 mg/kg in the samples.

Low levels of most metals were found, but did not approach the screening levels (SL) in the DMEF. Cu & Ni exceeded DEQ Level II screening levels; Cu & Ni levels are consistent in all the samples and consistent with other sample analyses from the Willamette Valley area and are considered background.

August Event: Fifteen (15) samples were submitted for TOC testing, data are presented in Table 9. The TOC ranged from 1180 to 240,000 mg/kg in the samples. No metals were run on these samples, because follow-up to the June sampling event, for metals, was determined not to be necessary.

Pesticides/PCBs (EPA method 8081A/8082), Phenols, Phthalates and Miscellaneous Extractables (EPA method 8270).

June Event: Five (5) samples were tested for pesticides/PCBs and the data are presented in Table 5. No PCBs were found at the MDL in any of the samples. No pesticides (except Σ DDT) were found at the MDL in any of the samples. Two phthalate compounds were detected in one sample each, and the values were well below their respective SLs. No phenols were detected in any samples above MDLs. One miscellaneous extractable (n-nitroso-di-n-propylamine)(DPN) was found in one (1) sample, COUG-G-07. This was not confirmed in the quality assurance (QA) split sample. This chemical is produced primarily as a research chemical and not for commercial purposes (Spectrum). DPN was not considered to be a chemical of further interest.

The following stations were tested for Σ DDT (with corresponding levels as indicated), two (2) samples were collected from East Fork cut banks (Σ DDT @ 8.5 & 32.6 ppb), one (1) sample below from the Slide Creek boat ramp, from a delta cut bank (Σ DDT @ 23.9 ppb), one (1) sample from the Annie Creek delta (Σ DDT @ 18.6 ppb), and one (1) sample was collected from lake deposits near the face of the dam on the Rush Creek side (Σ DDT @ 5.3 ppb).

August Event: Fifteen (15) samples were submitted for Σ DDT (DDT, DDE & DDE) analyses.

Appendix B
Cougar Reservoir Temperature Control Project
Sediment Quality Evaluation

Fifteen (15) samples were collected and analyzed for Σ DDT; two (2) background samples collected from the South Fork of the McKenzie above the reservoir (no Σ DDT detected, <2.6% fines); three (3) vertical profile samples from the cut-bank areas where only the fine-grained sediment was targeted in June (7.27, 7.11 & 17.65 ppb); five (5) surface composite sediment samples collected from the reservoir to represent the recently eroded and homogenized during the drawdown even (ND @ 0.7 ug/kg-ppb), 1.08, 4.77, 6.19 & 25.87 ppb). Each of these five (5) samples analyzed were a composite of 2-3 surface grabs from a designated area of the reservoir; two (2) surface samples from the McKenzie River, downstream of the dam (both ND @ <0.7 ppb) in slack water areas, where Σ DDT contaminated sediments might have been deposited, if it had migrated beyond the confines of the reservoir. One (1) upland station was sampled, upland on a logging road cut bank. Samples represented the surface to 6"depth and 6"-12" depth of forest floor debris (Σ DDT @ 374.6 ppb top 6") and (Σ DDT @ 36.9 ppb 6" – 12" depth).

Polynuclear Aromatic Hydrocarbons (EPA method 8270C).
June Event: Five (5) samples were submitted for testing, data are presented in Table 7 & 8. No "low or high molecular weight" PAHs were detected at the MDL in the samples.

August Event: No samples were submitted for method 8270C.

CONCLUSION

Dichlorodiphenyltrichloroethane (Σ DDT) was detected above levels of concern[1,2] in four (4) of the five (5) samples collected during the June sampling event. As a result of these findings, a follow-up sampling event was conducted on August 6-7, 2002, which analyzed fifteen (15) samples for physical parameters, total organic carbon (TOC) and Σ DDT. This event detected no Σ DDT present in surface sediments taken at two (2) locations in the McKenzie River, downstream of the dam or in two (2) samples from upstream of the reservoir (<2.6% fines). Only low levels of Σ DDT (<16% of S.L.) were detected near the inlet to the diversion tunnel, with one (1) of five (5) samples collected from within the current reservoir exceeding screening levels [1,2], for Σ DDT. Samples collected from potential future erosive sites, within the reservoir, also, contained Σ DDT at levels above the S.L [1,2].

The original source of the pesticide, dichlorodiphenyltrichloroethane, was likely from forest applications to public and private lands, in 1949, in this area to control budworm at a rate of approximately one (1) pound per acre. The one (1) upland station sampled, with two (2) analyses, was collected upland on a logging road cutbank and represented the surface to 6"depth and 6"-12" depth of forest floor debris (Σ DDT @ 374.6 ppb top 6") and (Σ DDT @ 36.9 ppb 6" – 12" depth). This level of Σ DDT is consistent with a one (1) pound per acre application, with a fifteen (15) year half-life of Σ DDT. The earlier material that eroded into the reservoir appears to have contained higher levels of Σ DDT than later sediments entering the reservoir; evidenced by surface sediments collected in the reservoir in the 1996 event and undisturbed surface lakebed sediments not containing detectable levels of Σ DDT, with sediments at lower levels containing higher levels of Σ DDT. The data would indicate that Σ DDT had collected behind the reservoir and then been covered with cleaner non-contaminated sediment, effectively isolating it from aquatic and benthic organisms. It is likely that this same "capping" effect will take place, covering any Σ DDT exposed during the drawdown events, following construction of the Temperature Control Structure when "normal" operation or the reservoir is resumed.

Appendix B
Cougar Reservoir Temperature Control Project
Sediment Quality Evaluation

While Σ DDT was detected in sediments within the reservoir and in upland samples, it was not measurable in sediments below the reservoir and only at low levels in areas near the inlet to the diversion tunnel outlet from the reservoir. It is likely that some floating organic material (fir needles, twigs, etc.), binding DDT, was released during the initial drawdown, but this material was likely distributed over a very large area, and not measurable nor posing any significant risk to the environment, due to dilution by distribution. Because Σ DDT is hydrophobic (little affinity for water) it will tend to remain bound to the organic material and not dissolve into the water column.

The sediment represented by sample COUG-G-26 contained Σ DDT at 25.87 ppb. This sample was a composite of two (2) samples, one (1) from the East near shore bank and one (1) from the West near shore bank, collected along a cross section, about half-way between the confluence of the East Fork and the South Fork from within the post drawdown 1400' pool. Because this material exceeds the SL guidelines, and is currently exposed to the water, it may require management. Best management practices in this case would likely be to allow natural attenuation (natural capping) to take place over time. Earlier testing of the lakebed sediments, prior to the drawdown, in the1996 sampling event were non-detect for Σ DDT. As part of the management strategy for this sediment it will likely include future sampling of this area after the construction period, when all drawdown and further erosion factors are complete, to determine if natural attenuation is effectively isolating the Σ DDT from benthic organisms exposure. Future erosion events will, also, potentially cover this sediment with new deposits that will need to be tested for Σ DDT levels.

The biggest potential for a future release of Σ DDT from Cougar Reservoir comes from the re-suspending and re-distribution of sediments currently exposed during the initial drawdown event. Vertical profile samples indicate sediments in former deposit sites contain Σ DDT above guideline SLs. As stated earlier, future sampling will need to be done to determine if Σ DDT is exposed within the pool from future erosive action.

Alternatives for pool depth (1400' vs. 1532'), drawdown rate (3'/day vs. 6'/day) and target date for reaching the 1400-foot level (March 1 vs. April 1) were discussed. The decision to keep the pool as close to the 1400-foot level as possible, after allowing pool elevation to rise to 1450' for protection of Bull Trout spawning, with a return to 1400' starting on December 1, 2002, was elected as the best management alternative. The differences between the pool level alternatives would likely have little effect on Σ DDT being released downstream. It is difficult to know which alternative might result in the greater re-suspending and re-distribution of sediments, but it is very unlikely that any erosion that occurs will cause greater suspending and distribution of sediments than the original event, which did not result in a measurable release in the sediment tested downstream of the dam.

Turbidity particulate and possibly some bedload sediment monitoring is recommended during the winter and spring seasons. Because Σ DDT binds to the finer-grained sediment particles and organic material, it is recommended that these fine-grained materials be monitored. While a sampling and analysis plan will need to be developed, it would likely include areas above and below the reservoir, upstream and downstream of the confluence of the South Fork and the Mainstem of the McKenzie River, with other possible areas to be determined.

Appendix B
Cougar Reservoir Temperature Control Project
Sediment Quality Evaluation

REFERENCES

1. U.S. Army Corps of Engineers, Portland District and Seattle District; U.S. Environmental Protection Agency, Region 10; Oregon Department of Environmental Quality; Washington State Department of Natural Resources and Department of Ecology. 1998 Final. Dredge Material Evaluation Framework for the Lower Columbia River Management Area.

2. U.S. Environmental Protection Agency and U.S. Army Corps of Engineers. February 1998. Evaluation of Dredged Material Proposed for Discharge in Inland and Near Coastal Waters - Testing Manual (referred to as the "Inland Testing Manual").

3. Clean Water Act, 40 CFR 230 (b)(1).

4. PSDDA. 1996. Puget Sound Dredged Disposal Analysis, Technical Information Memorandum, Testing, Reporting and Evaluation of Tributyltin Data in PSDDA and SMS Programs.

5. U.S. Army Corps of Engineers, Portland District. July 1998. Cougar Lake Willamette Temperature Control Intake Structure Modifications, Design Memorandum No. 21.

6. Project Report, Sediment Sampling, Willamette Temperature Control Project, Cougar Reservoir, Oregon. 29 February 1996, Prepared by Geotechnical Resources, Incorporated.

7. Spectrum Laboratories: Chemical Fact Sheet – Cas # 621647,

8. Oregon Department of Environmental Quality. December 2001. Guidance for Ecological Risk Assessment, Level II Screening Level Values Table 2. Screening Level Values for Freshwater and Marine Sediment.

9. Oregon Department of Environmental Quality. January 1997. OAR 340-122-045: Soil Cleanup Table.

10. Nowell, Lisa H., Capel, Paul D, Dileanis, Peter D. 1999. Pesticides in Stream Sediment and Aquatic Biota; Distribution Trends and Governing Factors. Lewis Publishers.

11. National Research Council. 1997. Contaminated Sediments in Ports and Waterways. National Academy Press, Washington D.C., U.S.A.

12. Canter, Larry W. 1996. Environmental Impact Assessment, 2nd Edition. McGraw Hill, Inc. New York, U.S.A.

13. Sittig, Marshall. 1981. Handbook of Toxic and Hazardous Chemicals. Noyes Publications Park Ridge, New Jersey, U.S.A.

Appendix B
Cougar Reservoir Temperature Control Project
Sediment Quality Evaluation

14. Nowell, L.H., Capel, P.D., Dileanis, P.D. 1999. Pesticides in Strean Sediments and Aquatic Biota. Lewis Publishers, Boca Rato, London, New York, Washington D.C., U.S.A.

15. Moore, D.G., Loper, R. 1966. DDT Residues in Forest and Soils of Western Oregon, September-November 1966. Pesticide Monitoring Journal Vol. 14, No. 3, December 1980.

16. Moore, D.G., Loper, B.R., 1980. DDT Residues in Forest Floors and Soils of Western Oregon, September-November 1966. U.S. Department of Agriculture, Forestry Sciences Laboratory, 3200 Jefferson Way, Corvallis Oregon 97331.

17. The Merck Index. 1976. The Merck Index, An Encyclopedia of Chemicals and Drugs. Merck and Co. Inc. Rahway, N.J., U.S.A.

[1] Dredge Material Evaluation Framework – Screening level for open water disposal 6.9 ug/kg total DDT.

[2] Oregon Department of Environmental Quality – Level II screening level 7.0 ug/kg total DDT.

[3] See Attachment A & B for complete Sampling and Analysis Plans

[4] Oregon Department of Environmental Quality - Upland Soil Cleanup Table (OAR 340-122-045 for Total DDT = 7000 ug/kg – ppb; (DDD = 3000 ppb; DDE = 2000 ppb & DDT = 2000 ppb).

Table 3. Cougar Temperature Control Project **Sampled June 4-5, 2002**

Physical Analysis

Sample I.D.	Grain Size (mm)		Percent			mg/Kg
	Median	Mean	Gravel	Sand	Silt/Clay	Volatile Solids
COUG-G-01	0.040	0.044	0.0	22.3	77.7	67200
COUG-G-02	0.032	0.033	0.0	13.3	86.7	57000
COUG-G-03	0.030	0.032	0.0	10.9	89.1	73000
COUG-G-04	0.040	0.047	0.0	27.1	72.9	69500
COUG-G-05	0.028	0.033	0.0	15.6	84.4	56800
COUG-G-06	0.094	0.093	0.0	73.0	27.0	82200
COUG-G-07	0.007	0.012	0.0	10.7	89.3	51300
COUG-G-08	0.017	0.023	0.1	6.0	93.9	54300
COUG-G-09	0.080	0.093	0.0	61.5	38.5	64500
COUG-G-10	0.008	0.014	0.0	3.2	96.8	72700
COUG-G-11	0.008	0.016	0.0	3.4	96.6	25600
COUG-G-13	0.027	0.034	0.6	16.9	82.5	68200
Mean	0.034	0.040	0.06	22.0	78.0	61858
Minimum	0.007	0.012	0.0	3.2	27.0	25600
Maximum	0.094	0.093	0.6	73.0	96.8	82200

Table 4, Cougar Temperature Control Project **Sampled June 4-5, 2002**

Inorganic Metals and TOC

Sample I.D.	As	Sb	Fe	Cd	Cu	Pb	Hg	Ni	Ag	Zn	TOC
	mg/kg (ppm)										
COUG-G-05	0.81J	0.37J B1	26500	<0.01	49.1B2	4.7B2	<0.022	41.1	0.23JB2	67.5B2	22400
COUG-G-07	2.25	2.4JB2	32900	<0.01	56B2	5.9B2	0.033	37.5	0.22JB2	62.3B2	10800
* COUG-G-07A	1.8	0.3	40900	0.42	53.2	4.9	<0.03	37.3	0.5	60.7	16800
COUG-G-09	1.1J	1.9JB1	13400	<0.02	25.7B2	3.5B2	0.04J	19	0.19JB2	32.5B1	103000
COUG-G-11	3.5	1.12JB1	36300	<0.01	44.3B2	11.5B2	0.05	25.7	0.36JB2	86.9B2	25700
COUG-G-13	2.7	0.68JB1	29500	<0.01	37.6B2	7.3B2	0.04	23	0.32JB2	62.1B2	20700
Screening level (SL) DMEF	57	150	+	5.1	390	450	0.41	140	6.1	410	
Screening level (SL) DEQ Level II	6	+	+	0.6	36	35	0.2	18	4.5	123	

+ No screening level established

* COUG-G-07A is the Quality Assurance lab sample splint for COUG-G-07

J = Estimated value (reported values are above the MDL, but below the PQL).

B1 = Low-level contamination was present in the method blank (reported level was < 10 times blank concentration).

B2 = Low-level contamination was present in the method blank (reported level was > 10 times blank concentration).

Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).

Pesticides, PCBs*, Phenols**, Phthalates and Extractables**

Sample I.D.	Pesticides				Phthalates		Herbicides
	ug/kg (ppb)						
	4,4'-DDD	4,4'-DDE	4,4'-DDT	Total DDT	bis(2-Ethylhexyl) phthalate	3 & 4 Methyl phenol	N-nitroso-di-n-propylamine
COUG-G-05	13.3	8.15	2.42 J	23.9	<78.6	<5.4	<2.5
COUG-G-07	3.38	3.7	1.45	8.5	<78.6	<5.4	32.4
* COUG-G-07A	1.10	0.616	<0.487	1.72	<28	<44	<22
COUG-G-09	17.9	6.34	8.39	32.6	<78.6	17.8	<2.5
COUG-G-11	2.75 J	2.57 J	<0.36	5.32	<78.6	<5.4	<2.5
COUG-G-13	9.62	6.06	2.93 J	18.6	110 J	<5.4	<2.5
Screening Level DMEF	DDD + DDE + DDT + = 6.9ppb				8300	670	28
Screening Level DEQ Level II	4 + 1.5 + 4 + = 7.0ppb				750	100	No freshwater value, marine number is 28

***No PCBs** were found in any sample at the MDL (<3.65ppb) (SL = 130 ppb).
****No Phenols or Extractables** were found in any sample at their respective MDLs.
* COUG-G-07A is the Quality Assurance lab sample splint for COUG-G-07
J = Estimated value (reported values are above the MDL, but below the PQL).
No other Pesticides or herbicides were detected at MDL
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).
All Total DDT values underwent second column confirmation.

Table 6, Cougar Temperature Control Project **Sampled June 4-5, 2002**

Polynuclear Aromatic Hydrocarbons (PAHs)

Low Molecular Weight Analytes

ug/kg (ppb)

Sample I.D.	Acenaphthene	Acenaphthylene	Anthracene	Fluorene	2-Methyl naphthalene	Naphthalene	Phen-anthrene	Total Low PAHs
COUG-G-05	<10.6	<9.4	<5.4	<10	<3.4	<10.1	<4.6	ND
COUG-G-07	<10.6	<9.4	<5.4	<10	<3.4	<10.1	<4.6	ND
* COUG-G-07A	<29.0	<19.0	<29.0	<19.0	<31.0	<50.0	<34.0	ND
COUG-G-09	<10.6	<9.4	<5.4	<10	<3.4	<10.1	<4.6	ND
COUG-G-11	<10.6	<9.4	<5.4	<10	<3.4	<10.1	<4.6	ND
COUG-G-13	<10.6	<9.4	<5.4	<10	<3.4	<10.1	<4.6	ND
Screen level (SL) DMEF	500	560	960	540	670	2100	1500	5200
Screen level (SL) DEQ Level II	57	160	57	77	+	176	42	76

* COUG-G-07A is the Quality Assurance lab sample splint for COUG-G-07
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit)

Polynuclear Aromatic Hydrocarbons (PAHs)

High Molecular Weight Analytes

ug/kg (ppb)

Sample I.D.	Benzo(b)-fluro-anthene	Benzo(k)-fluro-anthene	Benzo-(g,h,i)-perylene	Chrysene	Pyrene	Benzo(a)-pyrene	Indeno-(1,2,3-cd)-pyrene	Fluor-anthene	Total High PAHs
COUG-G-05	<9.5	<9.5	<3.6	<12.6	<7.1	<12.6	<5.0	<10.0	ND
COUG-G-07	<9.5	<9.5	<3.6	<12.6	<7.1	<12.6	<5.0	<10.0	ND
* COUG-G-07A	<39.0	<39.0	<32.0	<29.0	<25.0	<41.0	<30.0	<33.0	ND
COUG-G-09	<9.5	<9.5	<3.6	<12.6	<7.1	<12.6	<5.0	<10.0	ND
COUG-G-11	<9.5	<9.5	<3.6	<12.6	<7.1	<12.6	<5.0	<10.0	ND
COUG-G-13	<9.5	<9.5	<3.6	<12.6	<7.1	<12.6	<5.0	<10.0	ND
Screen level (SL) DMEF	b + k = 3200		670	1400	2600	1600	600	1700	12000
Screen level (SL) DEQ Level II	+	27	300	57	53	32	17	111	193

* COUG-G-07A is the Quality Assurance lab sample splint for COUG-G-07
J = Estimated value (reported values are above the MDL, but below the PQL).
Symbol (<) = Non-detect (ND) at the value listed (Method Detection Limit).

Table 8. Cougar Temperature Control Project **Sampled August 6-7, 2002**

Physical Analysis

Sample I.D.	Grain Size (mm)		Percent			mg/kg
	Median	Mean	Gravel	Sand	Silt/Clay	Volatile Solids
COUG-G-14	1.60	4.73	71.83	24.08	4.09	3190
COUG-G-15	1.20	3.74	42.89	49.94	7.17	3120
COUG-G-16	1.30	3.85	42.82	54.56	2.62	1390
COUG-G-17	0.59	0.36	0.00	98.44	1.56	3040
COUG-G-18	0.07	0.09	0.00	55.27	44.73	53700
COUG-G-19	1.20	4.44	46.20	41.97	11.82	7420
COUG-G-20	0.11	0.11	0.00	77.43	22.57	7470
COUG-G-21	0.12	0.11	0.00	72.20	27.80	5890
COUG-G-22	0.07	0.07	0.00	56.90	43.10	10100
COUG-G-23	0.09	0.07	0.00	61.74	38.26	14710
COUG-G-24	0.04	0.04	0.00	20.08	79.92	10630
COUG-G-25	0.03	0.04	0.00	21.55	78.45	8200
COUG-G-26	0.02	0.04	0.00	13.87	86.13	11980
COUG-G-27	0.04	0.31	4.05	35.11	60.84	8420
COUG-G-28	0.05	0.07	0.00	42.75	57.25	9330
Mean	0.47	1.29	14.8	51.85	40.45	11330
Minimum	0.02	0.04	0.00	13.87	1.56	1390
Maximum	1.60	4.73	71.83	98.44	86.13	53700

Table 9. Cougar Temperature Control **Sampled August 6-7, 2002**

Total DDT With Breakdown Products & Total Organic Carbon

ug/kg (ppb)

Location & Date Sampled	Description	Sample ID	DDD	DDE	DDT	Total DDT	TOC
			ug/kg (ppb)				mg/kg
DOWNSTREAM OF DAM Sampled August 6-7, 2002	Downriver by Powerhouse	COUG-G-14	<0.485	<0.574	<0.646	ND	16600
	Downriver by Gauging Station	COUG-G-15	<0.397	<0.469	<0.528	ND	6130
UPSTREAM OF RESERVOIR Sampled August 6-7, 2002	Upriver South Fork (South of bridge)	COUG-G-16	<0.189	<0.223	<0.252	ND	1180
	Upriver South Fork (South of bridge)	COUG-G-17	<0.174	<0.206	<0.232	ND	6780
UPLAND ABOVE RESERVOIR[4] **Sampled August 6-7, 2002**	Upland above reservoir - top 6" of 12" of forest floor	COUG-G-18	1.76 J	84.6	290	376.4	240000
	Upland above reservoir - bottom 6" of 12" of forest floor	COUG-G-19	<0.28	11.2	25.7	36.9	107000
SLIDE CREEK BANK DEPOSIT Sampled August 6-7, 2002	South Fork - Slide Creek, Vertical profile of COUG-G-06	COUG-G-20	4.76	2.51	<0.319	7.27	29100
	South Fork - Slide Creek, Vertical profile of COUG-G-05	COUG-G-21	3.62	2.63J	0.856J	7.11	20800

Total DDT With Breakdown Products & Total Organic Carbon

ug/kg (ppb)

SLIDE CREEK BANK DEPOSIT Sampled June 4-5, 2002	South Fork - Slide Creek	COUG-G-05	13.3	8.15	2.42J	23.9	22400
EAST FORK BANK DEPOSIT Sampled August 6-7, 2002	East Fork, Vertical profile of COUG-G-07	COUG-G-22	8.57	7.22	1.86J	17.65	30000
EAST FORK BANK DEPOSIT Sampled June 4-5, 2002	East Fork - target fine grain sediment	COUG-G-07	3.38	3.7	1.45	8.5	10800
EAST FORK BANK DEPOSIT Sampled August 6-7, 2002	East fork - Organic layer, Vertical profile of COUG-G-09	COUG-G-23	8.91	5.84	1.41J	16.16	64700
	QC Split of COUG-G-23 - Blind Duplicate	COUG-G-A	9.78	5.37	3.64	18.79	56900
	QA Split of COUG-G-23 -Duplicate to different laboratory	COUG-G-23QA	7.07J	5.59J	<2.24	12.66	54600
EAST FORK BANK DEPOSIT Sampled June 4-5, 2002	East fork - Target organic layer	COUG-G-09	17.9	6.34	8.39	32.6	103000
RESERVOIR POOL COMPOSITE SAMPLE Sampled August 6-7, 2002	East Fork - drawdown pool (Composite of 3 grabs)	COUG-G-24	2.11J	2.66J	<0.617	4.77	25800
	QC Split of COUG-G-24 - Blind Duplicate	COUG-G-B	1.48J	3.23J	<0.573	4.71	26600
	QA Split of COUG-G-24 - Duplicate to different laboratory	COUG-G-24QA	2.11J	3.87J	<2.83	5.98	32100

Table 9. Cougar Temperature Control **Sampled August 6-7, 2002**

Total DDT With Breakdown Products & Total Organic Carbon

ug/kg (ppb)

RESERVOIR POOL COMPOSITE SAMPLE Sampled August 6-7, 2002	South Fork - drawdown pool (Composite of 3 grabs)	COUG-G-25	3.11J	3.08J	<0.497	6.19	18200
RESERVOIR POOL COMPOSITE SAMPLE Sampled August 6-7, 2002	Halfway between S. Fork & E. Fork (Composite of 2 grabs)	COUG-G-26	12	4.62J	9.25	25.87	23300
RESERVOIR POOL COMPOSITE SAMPLE Sampled August 6-7, 2002	Around outlet to diversion tunnel (Composite of 3 grabs)	COUG-G-27	<0.437	1.08J	<0.582	1.08	15600
RESERVOIR POOL COMPOSITE SAMPLE Sampled August 6-7, 2002	East side of Reservoir at dam (Composite of 3 grabs)	COUG-G-28	<0.462	<0.547	<0.615	ND	13600

[4] Oregon Department of Environmental Quality - Upland Soil Cleanup Table (OAR 340-122-045) for Total DDT = 7000 ug/kg – ppb; (DDD = 3000 ppb; DDE = 2000 ppb & DDT = 2000 ppb).

Cougar Reservoir Temperature Control Project
Sampling and Analysis Plan